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**(54) Conversion of single to double hull - hull-up technique**

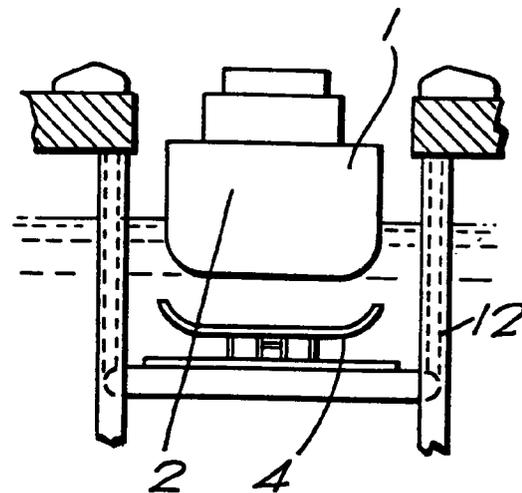
(57) A method of conversion of a single hull vessel to a double hull vessel.

The method including the steps of:

- a) positioning a section of a second hull (4) shell beneath a first hull (2) of a vessel;
- b) raising the section of second hull shell to locate it adjacent the first hull;
- c) attaching the section of second hull shell to the first hull.

The method also including locating the second hull shell in relation to the first hull by means of locating means in the form of male and female locating members.

*FIG. 7a*



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## Description

This invention relates to a method of conversion of a single hull vessel to a double hull vessel.

Owing to International concern over oil spillage from tankers, the International Maritime Organisation is putting in place regulations which mandate double hull tankers. Existing single hull tankers will need to be converted to double hulls within a specified period. (See Marpol Regulations effective from 6 July 1995 for crude oil tankers over 20,000 tons DWT and product tankers over 30,000 tons DWT).

In addition, the U.S. Oil Pollution Act 1990 requires all existing tankers to have double bottoms by 1997.

It is therefore recognised that a method of converting vessels from a single hull to a double hull is required. Existing methods of conversion require the vessel to be docked in a dry dock during which time the ship owners lose business. Known conversion techniques are carried out inside the vessel by adding a second hull within the existing hull. This has the disadvantage of reducing the available storage capability of the vessel.

Versatile ship lifting equipment is available with precise setting for accurate loading of vessels and this invention utilises such equipment.

Thus it is an object of the present invention to provide a time efficient method of conversion to a double hull vessel without sacrificing the internal capacity of the vessel.

According to the present invention there is provided a method of conversion of a vessel comprising the steps of:

- a) positioning a section of a second hull shell beneath a first hull of a vessel;
- b) raising the section of second hull shell to locate it adjacent the first hull;
- c) attaching the section of second hull shell to the first hull.

The method of conversion of a vessel may use a ship-lift system; alternatively, the method may be carried out in a dry dock.

Preferably, the section of second hull shell is lowered on a lifting means and the vessel is positioned above the lifting means.

The lifting means may thereafter be raised to bring the section of second hull shell into a position adjacent the first hull of the vessel. The locating of the section of second hull shell in relation to the first hull may be by means of a locating means such as male and female locating members disposed on adjacent portions of the first and second hulls.

Preferably, the lifting means lifts the combined vessel and section of second hull to a site for addition of remaining sections of the second hull and treatment.

Preferably, the second hull shell has transverse ribs for providing strength to the double hull.

The first hull may be an existing outer hull of a vessel, said vessel being converted to a double hull vessel.

Preferably, ballast tanks can be placed within the second hull. Existing ballast tanks within the first hull may be converted to cargo tanks.

Embodiments of the present invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a section of second hull used in accordance with the method of the present invention;

Fig. 2 is a cross-section of the locating means between the first and second hulls in accordance with the method of the present invention;

Fig. 3 is a side elevation of a vessel in accordance with the method of the present invention;

Fig. 4a and 4b are a side elevation and a cross section of the section of the second hull of Fig. 1;

Fig. 5a and 5b are a side elevation and an end elevation of a vessel having a section of second hull located and being lifted in accordance with the method of the present invention;

Fig. 6a and 6b are a side elevation and an end elevation of a vessel having remaining sections of second hull attached in accordance with the method of the present invention;

Fig. 7a and 7b are cross-sections of a section of second hull on a lift platform before and after attachment to a first hull in accordance with the method of the present invention;

Fig. 8a and 8b are diagrammatic plan views of a vessel with a section of second hull attached and with additional sections attached respectively in accordance with the method of the present invention; and

Fig. 9a and 9b are side elevations of a vessel with a first hull showing male locating members in accordance with the method of the present invention.

Referring to the drawings, a method of conversion of a vessel is described, in particular for adding a second hull 4 to a vessel 1 with a single existing hull 2 (see Fig. 3 and Figs. 9a and 9b).

The method can be used in a dry dock or by using a ship-lifting system. The ship-lifting system has the advantage of a quicker assembly time thereby being advantageous to shipowners who have their ships out of service for a shorter period.

The method involves the following steps. The vessel 1 is identified for conversion to a double hull vessel and all the key drawings for the vessel 1 are obtained from the shipowner or drawn up to provide details of the general arrangement and construction profile, the shell expansion, capacity plan, lines and offset and the piping arrangement. The vessel 1 may need to be brought to the shipyard for detailed checking of the vessel profile and to verify all critical dimensions.

The main bottom section of second hull 4, side sections 18 and end sections 20 are fabricated as steel structures based on the drawings (see Figs. 4a, 4b and 8b).

The bottom section of second hull 4 has sets of female locating members 8 attached to correspond with male locating members 6 on the vessel 1. Corresponding male locating members 6 (See Fig. 2) are added to the exterior of the existing first hull 2 of the vessel 1. The male and female locating members 6, 8 facilitate precise positioning of the bottom section of second hull 4 in relation to the first hull 2 of the vessel 1.

The bottom section of second hull 4 has parallel transverse ribs 10 normal to the direction of the keel 22 of the vessel 1. The ribs 10 strengthen the section of the second hull 4 and provide rigidity (see Fig. 1).

The side sections of second hull 18 are hollow blocks and the end sections of second hull 20 are tapered hollow blocks (see Fig. 8b).

New pipes and other fittings are prefabricated for fitting in new double bottom tanks which will be ballast tanks between the first and second hulls 2, 4. Any original ballast tanks within the first hull 2 of the bottom vessel 1 are converted to cargo tanks.

The sections 18, 20 of the second hull 4 are blasted and painted. This completes the preparation that can be carried out without having the vessel 1 out of commission (see Figs. 4a, 4b and 8b).

At this time, the vessel 1 is docked and lifted by a ship lift 12 and transferred to a land berth. Alternatively, the vessel 1 could be docked in a dry dock (see Fig. 6a).

The existing external shell 19 of the first hull 2 of the vessel 1 is completely blasted and painted with a primer (see Fig. 9a and 9b). The male locating members 6 are fitted onto the bottom plate of the first hull 2 of the vessel 1.

The vessel 1 is transferred from the land berth to the ship lift platform, lowered and floated. Alternatively, if the dry dock system is being used, the vessel 1 is floated and removed from the dry dock.

The main bottom section of second hull 4 which has been prefabricated as described above, is assembled on the land berth over suitable cradles and bogies. The section of second hull 4 is transferred to the platform 14 of the ship lift 12 and the platform 14 is lowered into the sea (see Figs. 4a and 4b).

Referring to Figs. 5a and 5b, the vessel 1 is docked over the platform 14 of the ship lift 12 ensuring sufficient clearance between the vessel's first hull 2 and the section of second hull 4 on the platform 14.

The platform 14 is then raised by the ship lift 12 so that the male locating members 6 on the first hull 2 fit accurately into the female locating members 8.

The vessel 1, now with a double hull on the bottom portion, formed of the first hull 2 and the section of second hull 4, is transferred to the land berth.

If the dry dock arrangement is being used, the section of second hull 4 is supported on blocks. The dry

dock can be flooded in order to allow the vessel 1 to be positioned over the second hull 4. The dry dock can be drained for further work on the vessel 1 as described below.

The exterior of the first hull 2 and the interior of the bottom section of second hull 4 are thoroughly washed with fresh water and the first and second hulls 2, 4 are welded together.

A number, in this example four, of side sections of second hull 18 in the form of hollow blocks having a double skin shell structure are positioned on each side of the vessel 1 adjacent the first hull 2 and above the bottom section of the second hull 4, by yard cranes (see Figs. 6a and 6b).

End sections 20 of the second hull 4 are also positioned on the vessel 1 and these have a tapered profile at the forward and aft ends of the vessel 1 in order to ensure that the first hull 2, bottom section of second hull 4 and side sections 18 of second hull 4 are jointed smoothly.

The remaining modification works such as installing new ballast pipes, bottom plugs, sea chests and relocating or modifying underwater fittings are carried out.

Upon completion of the works, the vessel 1 with its double hull is transferred to the platform 14 of the ship lift 12 and lowered into the sea. If the dry dock system is being used, the dry dock is flooded and the vessel 1 floated (see Fig. 7b).

The entire vessel systems are tested and a sea trial conducted.

The resulting double hull vessel has a first hull 2 which is the existing hull of the vessel 1, with a bottom section of second hull 4 located to the first hull 2 by male and female locating members 6, 8 between the two, the second hull is then attached by welding. A number of double skinned side sections 18 of second hull 4 are disposed along the sides of the vessel 1 with tapered end sections 20 of second hull 4 at each forward and aft position.

Improvements and modifications can be made to the above without departing from the scope of the present invention.

## Claims

1. A method of conversion of a vessel comprising the steps of:
  - a) positioning a section of a second hull shell beneath a first hull of a vessel;
  - b) raising the section of second hull shell to locate it adjacent the first hull;
  - c) attaching the section of second hull shell to the first hull.
2. A method of conversion of a vessel as claimed in claim 1, wherein a ship-lift system is used.

3. A method of conversion of a vessel as claimed in claim 1, wherein the method is carried out in a dry dock.
4. A method of conversion of a vessel as claimed in any one of claims 1 to 3, wherein the section of second hull shell is lowered on a lifting means and the vessel is positioned above the lifting means. 5
5. A method of conversion of a vessel as claimed in claim 4, wherein the lifting means is raised to bring the section of second hull shell into a position adjacent the first hull of the vessel. 10
6. A method of conversion of a vessel as claimed in any one of the preceding claims, wherein the section of second hull shell is located in relation to the first hull by means of a locating means such as male and female locating members disposed on adjacent portions of the first and second hulls. 15 20
7. A method of conversion of a vessel as claimed in any one of claims 4 to 6, wherein the lifting means lifts the combined vessel and section of second hull to a site for addition of remaining sections of the second hull and treatment. 25
8. A method of conversion of a vessel as claimed in any one of the preceding claims, wherein the second hull has transverse ribs for providing strength to the double shell hull. 30
9. A method of conversion of a vessel as claimed in any one of the preceding claims, wherein the first hull is an existing outer hull of a vessel, said vessel being converted to a double hull vessel. 35
10. A method of conversion of a vessel as claimed in any one of the preceding claims, wherein ballast tanks are placed within the second hull. 40
11. A method of conversion of a vessel as claimed in claim 10, wherein existing ballast tanks within the first hull may be converted to cargo tanks. 45

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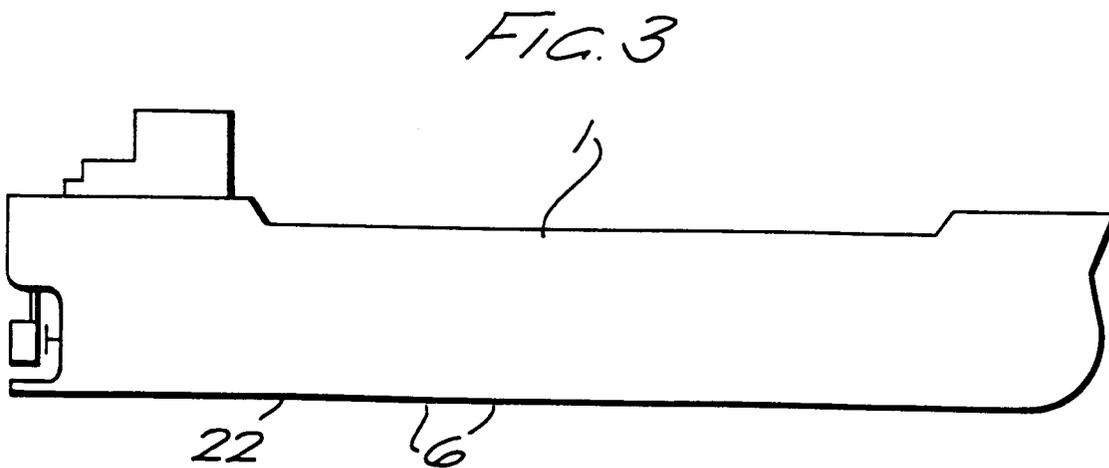
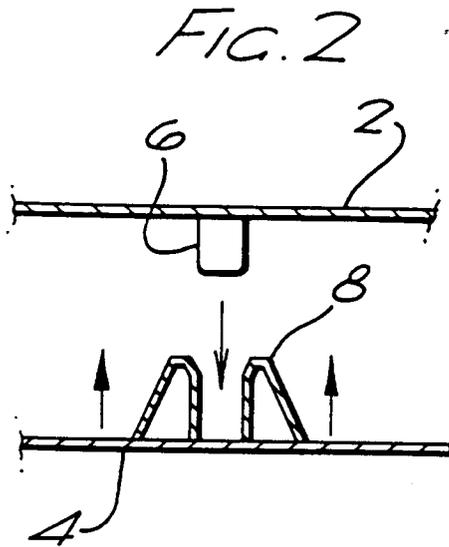
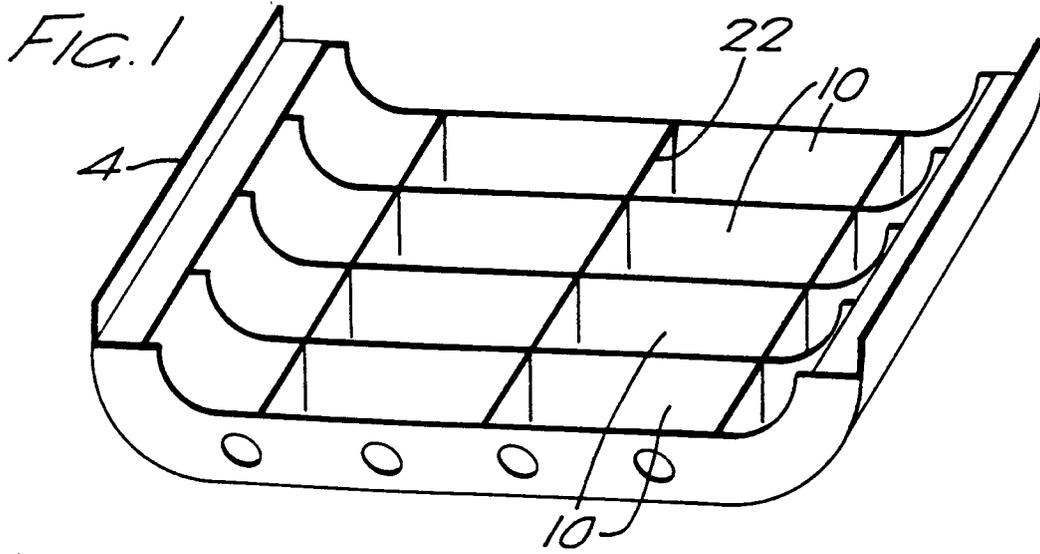


FIG. 4a

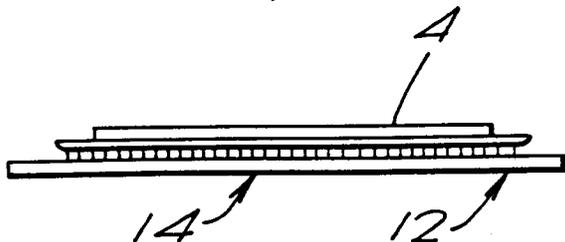


FIG. 4b

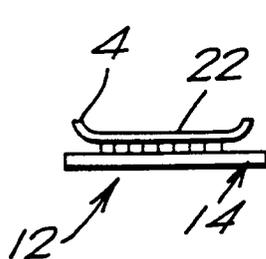


FIG. 5a

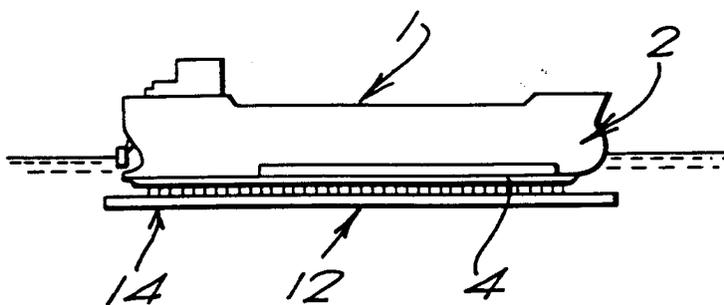


FIG. 5b

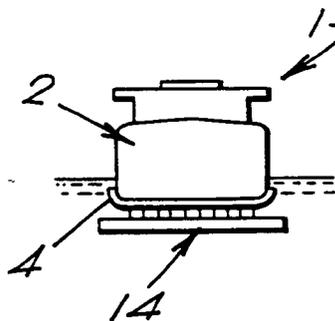


FIG. 6a

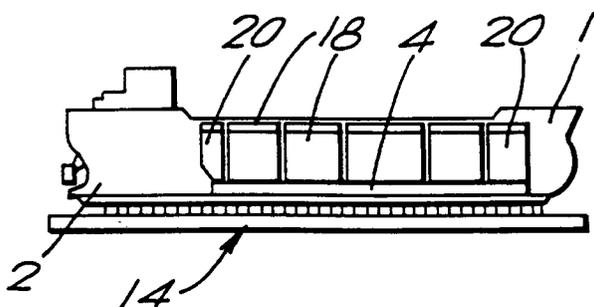


FIG. 6b

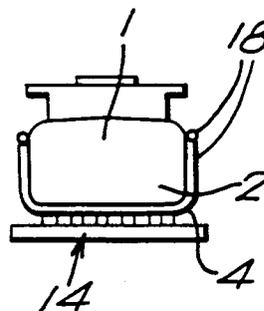


FIG. 9a

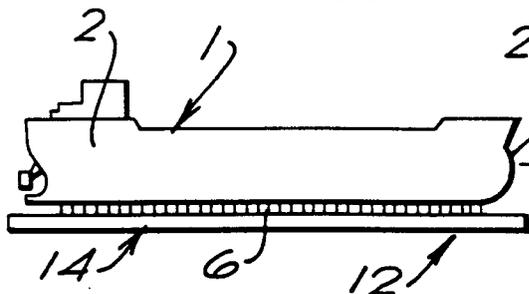
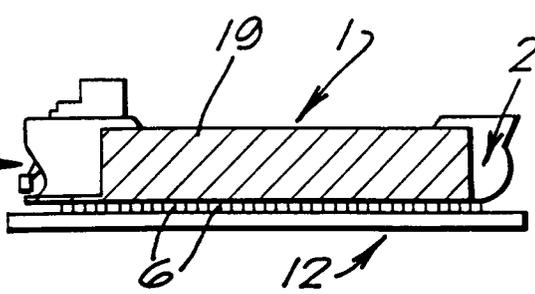
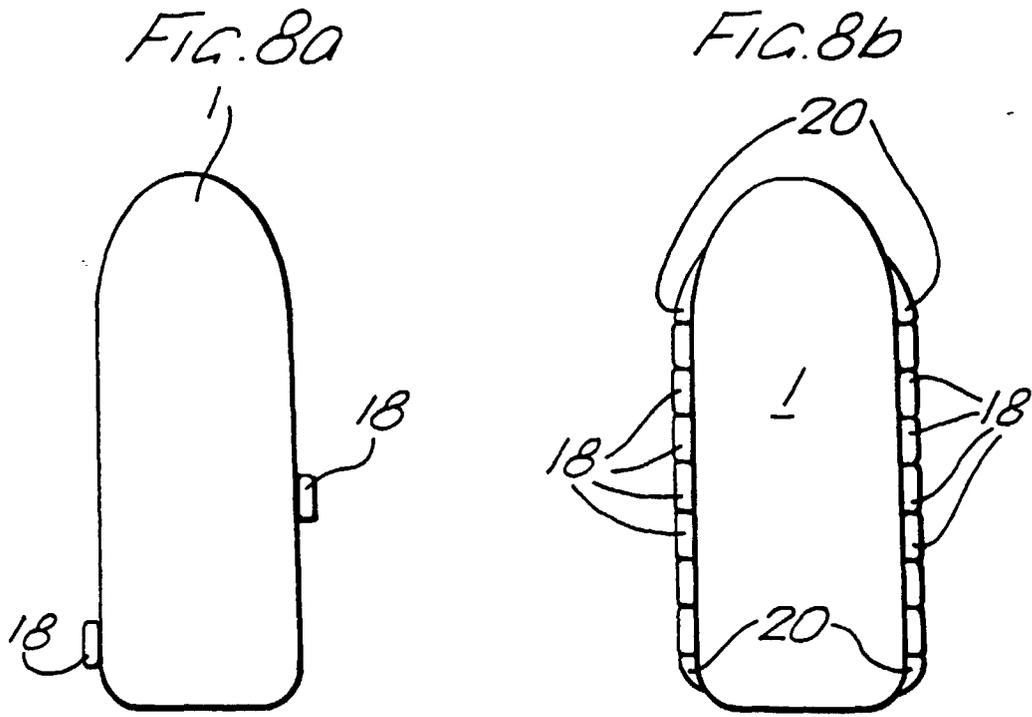
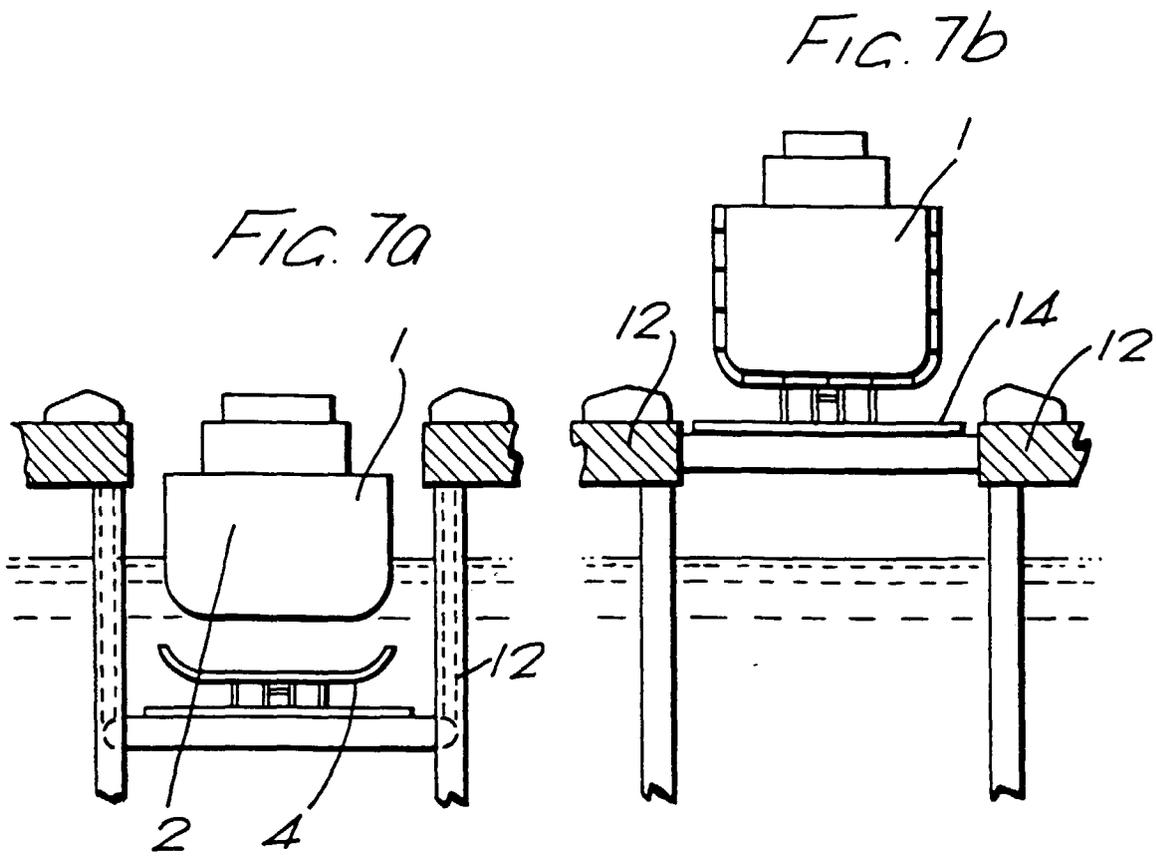


FIG. 9b







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EUROPEAN SEARCH REPORT

Application Number  
EP 97 30 0560

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO 94 26585 A (SPECIAL PROJECTS RESEARCH CORP.)	1,3,9	B63B9/04
Y	* page 22, last paragraph - page 23, paragraph 1; figure 23 *	4-6,8,10,11	
Y	US 3 978 807 A (NITZKI) * figures 1-4 *	4-6	
Y	PATENT ABSTRACTS OF JAPAN vol. 015, no. 393 (M-1165), 4 October 1991 & JP 03 159895 A (ISHIKAWAJIMA HARIMA HEAVY IND CO LTD), 9 July 1991, * abstract *	8	
A		7	
Y	WO 92 10396 A (STUART) * abstract; figures 1-4 *	10	
Y	US 5 189 975 A (ZEDNIK) * abstract; figures 1-3 *	11	
			B63B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		25 June 1997	DE SENA, A
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